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Two new orchid-pollinating wasps (Hymenoptera: Thynnidae) from Australia

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ABSTRACT

Two new species of Australian flower wasps (Thynnidae) are described, each being known only from the male. They are *Arthrothynnus latipinnus* sp. nov. from the sandstone escarpment of western Arnhem Land in the Northern Territory, the pollinator of the Robust Elbow Orchid (*Arthrochilus latipes*), and *Lestricothynnus hastata* sp. nov. from south-western Victoria, the pollinator of the threatened Mellbolm's Spider Orchid (*Arachnorchis hastata*).

KEYWORDS: Australia, Northern Territory, Victoria, Hymenoptera, Thynninae, *Arthrothynnus*, *Lestricothynnus*, Orchidaceae, *Caladenia*, orchid pollinators.

INTRODUCTION

Relatively little is known about insect-vectored pollination of Australian native plants, yet an understanding of pollinator biology, as well as plant pollination strategy, is essential for the management of rare and endangered plants. Arguably one of the most interesting strategies for plants is that of sexual deception. Orchids of the subfamily Diuridae, including such genera as *Chiloglottis*, *Caladenia*, *Arthrochilus* and *Drakaea*, have flowers that produce chemicals mimicking the sex pheromones of female thynnine wasps (Schiestl *et al.* 2003; Schiestl 2004). These chemicals lure and deceive males into attempting to mate with the flower. This behaviour achieves pollen transfer and ultimately pollination (Bower 1992; Brown 1997b).

Of particular interest with this strategy is that the wasp-orchid relationship is species-specific, such that a single species of wasp pollinates a single species of orchid. This relationship has been tested experimentally using picked and translocated flowers as bait for wasps (Bower & Brown 1997). Flowers that consistently attract the same species of wasp are conspecific, while those that attract a different species are not. This baiting method has become a standard technique for recognising cryptic species of orchid (Bower & Brown 2009).

The two species of wasps described here belong to unrelated genera – *Arthrothynnus*, which was erected and reviewed by Brown (1997b) and contains many pollinators of *Arthrochilus* orchids, and *Lestricothynnus*, a genus not previously recognised as including specific orchid pollinators. These wasps are the pollinators of the Robust Elbow Orchid, *Arthrochilus latipes* D.L. Jones and Mellbolm's Spider Orchid, *Arachnorchis hastata* (Nicholls) Rupp. respectively. The latter is listed as a threatened species and was thought to be extinct until the discovery of six plants in 1996 (DSE 2006).

Terminology follows Snodgrass (1941), Brown (1997a, b) and Naumann (1991). Relative terms relating to microsculpture are interpreted as follows: sparsely punctate = punctures greater than two puncture-diameters apart; punctate = punctures at most two puncture-diameters apart, but never confluent; closely punctate = punctures almost confluent; rugosely punctate = punctures partially confluent; finely punctate = punctures small and shallow; coarsely punctate = punctures large and deep; obscurely punctate = punctures small, sparse, shallow and only visible at certain angles.

Abbreviations. Morphological characters: T1–7, metasomal tergites 1–7; S1–8, metasomal sternites 1–8. Specimen repositories: ANIC, Australian National Insect Collection, CSIRO, Canberra; BMNH, Natural History Museum, London; MV, Museum Victoria, Melbourne; NTM, Museum and Art Gallery of the Northern Territory (formerly Northern Territory Museum), Darwin.

SYSTEMATICS

Arthrothynnus Brown, 1997

Gender masculine. Type species, by original designation, *Arthrothynnus huntianus* Brown, 1997. Recent, Mt Canobolas, New South Wales, Australia.

A diagnosis for the genus was given by Brown (1997b), and the species described here is the seventh species to be placed in *Arthrothynnus*.

This genus was erected for six undescribed species from south-eastern Australia including some that pollinate terrestrial orchids of the genus *Arthrochilus* (Brown 1997b). Currently there are 10 species of *Arthrochilus* with one

Figs 1–3. *Arthrothynnus latipinnus* sp. nov., male: **1**, head; **2**, habitus; **3**, S8, ventral; **4**, Blooms of orchid *Arthrochilus latipes*. Scale lines: 1 = 0.5 mm; 2 = 10 mm; 3 = 0.1 mm; 4 = 5 mm. All photographs: author except Fig 4, which is courtesy Ian Morris.

extending into New Guinea plus a further five species placed in the closely related genera *Phoringopsis* or *Thynninorchis* (Jones *et al.* 2002). All are likely to be pollinated by species of *Arthrothynnus* that are as yet uncollected or unrecognised.

There are two species of orchid in the Northern Territory that are, or are likely to be, pollinated by a species of thynnine wasp. Firstly, *Arthrochilus latipes* D.L. Jones is an orchid that occurs in *Allosyncarpia* forest at the base of the sandstone escarpment and flowers in the late dry season/early wet season and its pollinator is described here. Secondly, *Phoringopsis byrnesii* (Blaxell) D.L. Jones & M.A. Clem. is an orchid that occurs on the top of the sandstone escarpments and flowers in the middle of the wet season. The latter is inaccessible during the flowering season without a helicopter, and the pollinator is yet to be collected. There are further species of orchids in northern Queensland for which the pollinators are also as yet unknown.

Arthrothynnus latipinnus sp. nov.

(Figs 1–4)

Material examined. Holotype – NTM I.5918,♂, Northern Territory, near Oenpelli Allosyncarpia forest track, attracted to *Arthrochilus latipes* flowers, 12°23'S, 133°01'E, 30 November 1996, G.R. Brown & J. Purdie.

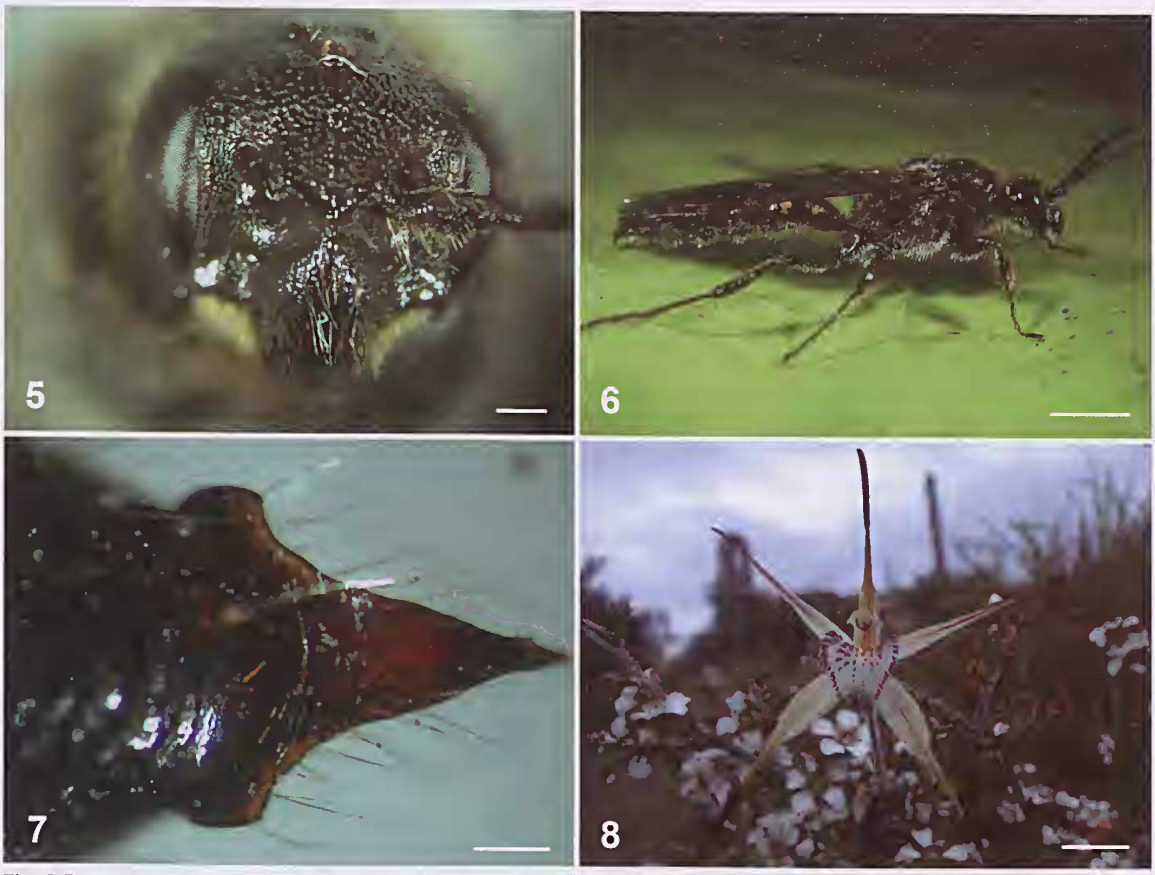
Paratypes – ANIC, BMNH, NTM, QM, 7♂, same data as holotype; NTM, 3♂, 12°22'S, 133°03'E, near Oenpelli reservoir, 27 November 1996, G.R. Brown & J. Purdie; NTM, 1♂, Kakadu National Park, Anbangbang Billabong, 12°52'S, 132°48'E, 25 February1996, G.R. Brown.

Description of male. Body (Fig. 2) length 6–8 mm; fore wing 5–6 mm; hind wing 4–5 mm.

Clypeus weakly raised medially, finely rugosely punctate, apical margin narrowly truncate (Fig. 1); frons rugosely punctate; antennal prominence transversally carinate (discontinuous medially); vertex and gena finely rugosely punctate.

Pronotum slightly swollen laterally, deeply and closely punctate, anterior end raised and subcarinate; mesoscutum and mesoscutellum deeply and closely punctate; metanotum closely punctate; propodeum rugosely punctate and transversely striate, dorsal surface impunctate; mesopleuron rugosely punctate; fore coxae closely and finely punctate, small, conical with shallow depression apically on ventral surface.

Metasoma elongate fusiform, T3–4 widest, T1 as wide as long; tergites sparsely punctate, polished; epipygium deeply and closely punctate, apical margin with transverse sinusoidal carina and narrow membranous plate laterally;



Figs 5–7, *Lestricothynnus hastata* sp. nov., male: **5**, head; **6**, live specimen; **7**, apex of metasoma, dorsal; **8**, Bloom of orchid *Arachnorchis hastata* (in front of *Leptospermum continentale* flowers). Scale lines: 5 = 5 mm; 6 = 4 mm; 7 = 0.1 mm; 8 = 20 mm. All photographs: author.

sternites closely punctate, closer on S1, anterior groove on S2–5 serobiculate; S1 medially raised; hypopygium (S8) subparallel, lateral spines long, acute and divergent, apical spine long and narrow (Fig. 3).

Genitalia with parameres (in profile) subparallel and curved downward, margins gently converging distally and narrowly subtruncate apically; basiparameres (dorsally collectively) long with margins parallel basally, and convergent and subtriangular apically and subtruncate apically; cuspis short, subtriangular, apex slightly inturned with small preapical tooth on outer margin, digitus larger and arising from the outer surface ventrally.

Colour. Black; mandibles (except tip) with small transverse yellow mark above antennal insertion; anterior margin of pronotum (discontinuous medially) and disc of metanotum completely yellow. Wings hyaline to weakly infuscate, veins dark brown to black. Setae white.

Distribution. Known only from the Oenpelli area and adjacent regions of Kakadu National Park, Northern Territory, Australia.

Remarks. This species is tentatively placed in *Arthrothynnus* because of the structure of the antennal prominence, clypeus, metasoma, and hypopygium as these preclude it from all other available genera. The subtruncate rather than deeply emarginate apex of the basiparameres (combined) distinguishes this species from all the other *Arthrothynnus* species and also suggests that this species may warrant a separate new genus. However, I am reluctant to create a new genus without seeing other species from northern Australia.

Arthrothynnus latipinnus keys to *A. huntianus* Brown in the key given by Brown (1997b), but *A. huntianus* has orange legs and the metasoma is longer than the mesosoma. In comparison as stated above, the legs of *A. latipinnus* are black and the metasoma is shorter than the mesosoma.

Arthrothynnus latipinnus is presumed to be the pollinator of the orchid of *Arthrochilus latipes* (Fig. 4) based on its strong attraction to flowers of this orchid that were picked from the *Allosyncarpia* forest near Oenpelli and moved about 100 m away. Although no pollen transfer was observed, this strong attraction is typical of thynnine orchid pollinators (pers. obs.).

The only other known pollinators of *Arthrochilus* orchids are *Arthrothynnus huntianus*, which pollinates *Thynninorchis* (= *Arthrochilus*) *huntianus* (F.Muell.) D.L. Jones & M.A. Clem. in Victoria and New South Wales, and

Arthrothynnus rufiabdominalis Brown, which pollinates *Arthrochilus irritabilis* F. Muell. in Queensland.

Etymology. This species name is derived from a combination of the epithet of the orchid which this wasp pollinates and the Latin suffix *-inus* meaning pertaining to. It is intended as a noun in apposition.

***Lestricothynnus* Turner, 1910**

Gender masculine. Type species, by original designation, *Thynnus nubilipennis* Smith, 1879. Recent, Queensland, Australia.

A diagnosis for *Lestricothynnus* was given by Brown (2009). Currently there are 16 described species in the genus including three not currently placed in this genus (Brown pers. obs.) in addition to the species described here.

Males of the genus *Lestricothynnus* are mostly large in comparison to other thynnine wasps and they are extensively covered in yellow markings. They have not been reported previously as orchid pollinators, although *L. modestus* is probably the pollinator of *Arachnorchis corynephora* A.S. George with two undescribed species probably pollinating *Arachnorchis clavula* D.L. Jones and *Arachnorchis septuosa* D.L. Jones, respectively (Brown pers. obs.).

Arachnorchis is a large and diverse genus of ground orchids with 132 species and 18 subspecies described and many more undescribed (Jones 2006). These taxa are divided into 10 species groups with most of them being pollinated by thynnine wasps (Jones 2006). However, it should be noted that the validity of this genus is not universally accepted, and species are often referred to *Caladenia* R. Br. where they were placed previously (e.g. Phillips *et al.* 2009). A more detailed discussion of *Caladenia sensu lato* is also given in Phillips *et al.* (2009).

To date, 11 genera of thynnine wasps have been recorded as being attracted to *Arachnorchis* flowers (i.e. *Aeolothynnus*, *Campylothynnus*, *Chilothynnus*, *Lophocheilus*, *Macrothynnus*, *Neozeleboria*, *Phymatothynnus*, *Tachynomyia*, *Thynnoides*, *Zaspilothynnus* and *Zeleboria*) (Brown & Bower pers. obs.).

***Lestricothynnus hastata* sp. nov.**

(Figs 5–8)

Material examined. Holotype – NTM (I.5819), ♂, Victoria, east-west track (*Goodenia* site), Point Danger, near Portland, 19 October 2009, K. Vlcek & G.R. Brown. Paratypes – Victoria: MV, NTM (not registered), 4♂ – same location as holotype but: 29 October 2009, K. Vlcek and G.R. Brown (MV 1♂); 7 November 2009, K. Vlcek (MV 1♂); 8 November 2009, K. Vlcek (NTM not registered, 2♂).

Description of male. Body (Fig. 6) length 16 mm; fore wing 11 mm; hind wing 8 mm.

Clypeus closely and finely punctate, disc punctate with punctures deeper; antennal prominence broadly rounded, flat, not distinctly carinate, weakly sagittally sulcate to near mid-ocellus and ending short by 1 ocellus diameter; frons rugosely punctate, punctures larger dorsally (Fig. 5); vertex and gena finely and rugosely punctate with punctures coarser at level of ocelli; occipital carina almost continuous dorsally.

Pronotum closely and finely punctate with anterior margin sharply raised, but not carinate, not laterally produced, narrower than posterior margin and head; mesoscutum, tegulae, mesoscutellum and metanotum closely and finely punctate; mesoscutellum (in profile) mostly flat, convex anteriorly, propodeum closely to rugosely punctate and transversely multistriate, sagitally grooved anteriorly, obliquely and slightly rounded in profile, dorsal surface not delineated, lateral surfaces weakly separated and longitudinally multistriate dorsally; scrobal groove short almost horizontal, not quite reaching posterior margin; fore coxae punctate, shallowly concave over most of surface with apical angle produced, triangular and directed perpendicularly; mesopleura longitudinally multistriate.

Metasoma elongate, slightly flattened, constricted between segments; tergites punctate to closely punctate, closer on T1–2, not as close on disc of most tergites, deeper on posterior segments; T1 as wide as long, spiracles raised; sternites rugosely punctate; T7 apically subtruncate with 3 strong U-shaped carinae, membranously produced beyond carinae; S1 longitudinally convex with short sagittal groove apically, slightly longer than wide; S2–5 tuberculate, in profile tubercles progressively larger from S2 to S5 with those on S4–5 subequal in size, tubercles visible ventrally as posterolateral carinae that converge and are more strongly raised posteriorly with carinae forming the ridge of the tubercle; hypopygium (S8) with basal angles produced and truncate without spines, abruptly rounded distally then narrowly triangular to delicate upturned apical spine, transversely multicarinate dorsally (Fig. 7).

Genitalia with paramcres narrow with margins parallel and slightly curved over most of length; acdeagus very narrow; digiti large, setose on outer surface, subtruncate distally, conspicuous in profile; cuspides narrow, almost lamellate, vertical, parallel, and elongate subtriangular.

Colour. Black; mandibles (except tip) pale yellow, yellow on inner and outer orbits between base of mandibles and level of antennal insertions and briefly extending onto margin of clypeus laterally; transverse yellow line laterally on vertex behind eye; elongate yellow spot on mesoscutellum; small yellow spot on metanotum; and small lateral yellow spot on T1–4 (larger on T2). Wings hyaline, veins brown. Setae mostly white but darker on frons, vertex, pronotum and mesoscutum.

Distribution. Coastal south-western Victoria in heath near Portland.

Etymology. This species takes its name directly from that of the orchid it pollinates, *Arachnorchis hastata* (Nicholls) Rupp (Fig. 8). It is intended as a noun in apposition.

Remarks. The yellow spots on the tergites are unusually variable and may be reduced or absent, but they are always small when present. This is unusual in the genus

Lestricothynnus, in which all species except *L. vigilans* are extensively marked with yellow or orange.

Also unusual within the subfamily is the pallor of the mandibles, the sternal tubercles and the narrow parameres. These characters are rare and occur in a few unrelated species, although the latter is typical of the genus *Catocheilus*. Narrow parameres also occur in at least one undescribed species of *Thynnoides* as well as *L. vigilans*. The sternal tubercles are unique within the genus.

Within the genus, *Lestricothynnus hastata* could only be confused with *L. vigilans* (Smith), but is readily distinguished by the presence of tubercles on the sternites. These two species are distinct, and are part of a complex of species present in south-eastern Australia that needs to be resolved with molecular studies.

DISCUSSION

Neither of the two Northern Territory orchid species pollinated, or potentially pollinated, by thynnine wasps is presently listed as threatened (http://www.nt.gov.au/nreta/wildlife/animals/threatened/specieslist.html#plants). However, *Phoringopsis byrnesii* is restricted to sandstone escarpments and it only flowers during the wet season. As such, it (and its thynnine pollinator, which is presently unknown) is inaccessible and its conservation status is unclear (i.e. Data Deficient). Previously it has been considered threatened (Briggs & Leigh 1995).

However, orchids in southern Australia are under higher pressure from land clearing and other human interference. In addition, more species are listed as threatened (Jones 2006) and a larger proportion are known to be pollinated by thynnine wasps (Brown & Bower pers. obs.). Despite the status of these orchids, management programs tend to concentrate on the propagation of more plants rather than on the factors that affect the abundance of the pollinator, even when the wasps are rare or unknown (Brown & Vleek 2009). Mellblom's Spider Orchid is currently one of Australia's rarest orchids. It was plentiful in the 1950s but suffered a rapid decline in numbers with only six plants existing in 1996 (DEWHA 2009). Propagation and management had increased this number to 180 flowering plants plus 600 seedlings a decade later (DSE 2006). However, the discovery of the pollinator is a major breakthrough for the long term management of this orchid.

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